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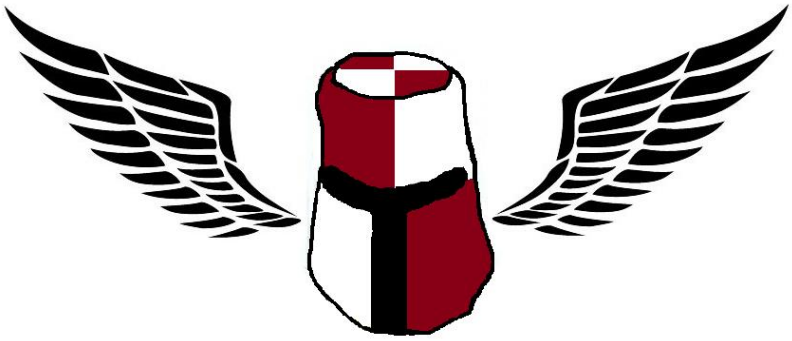

Patrol Crusaders
Neighborhood Patrol Drone
Architecture Design Specification

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1. Introduction

1.1 Document Overview

System test plan will provide the detail view of the testing process that will be done by team while building Neighborhood Drone Patrolling (NPD). In this document results of various tests such as unit tests, component test, integrated test and system verification will be recorded. This document will be based on the previously established document such as System Requirements Specification document, Architecture Design Specification (ADS) and Detail Design Specification (DDS). System Requirements Specification (SRS) document will provide the requirement specification of the system, Architecture Design Specification will provide the detail of subsystem of each layer and Detail Design Specification provides the detail of modules of each subsystem.

1.2 Product Concept

The NPD has various functionalities and requirements. The NPD will revolutionize the surveillance system and make it modern and attractive as the Drone is being flown over with the on board camera in order to capture the live feeds of the surroundings. Then, the NPD will also perform basic image processing and the system consist of the following processes like getting images out of the video, adding new users who will get the notification if the system observes the activities which are suspicious. The drone will fly in the pre given path (pre given height and flying path). The drone will be flown automatically and will have a fail switch, as the Drone can be controlled using the controller by the user if necessary. The video and the location of the image will be captured along with its battery power and transported to the base station using radio frequency. Thus, the main purpose of the NPD is to provide a security to the people in the neighborhood and reduce the criminal activities by alerting the people living in the neighborhood. The NPD will notify its user about anything suspicious happening in the neighborhood. Therefore, the NPD will enhance the security of the neighborhood and will help keeping people alert and safe.

1.3 Product Scope

The NPD will fly in a predefined path over a neighborhood. The NPD will be able to do so with limited to none human interaction. The NPD contains one on-board camera. The camera can record videos as well as still images. The video is streamed to a server where the user can access it via a mobile phone using an Android application or from a website. The videos are stored for five days so that the user can go back and refer to it in case such a need arises. Real time image processing is done on the streamed video to detect any unseemly activities.

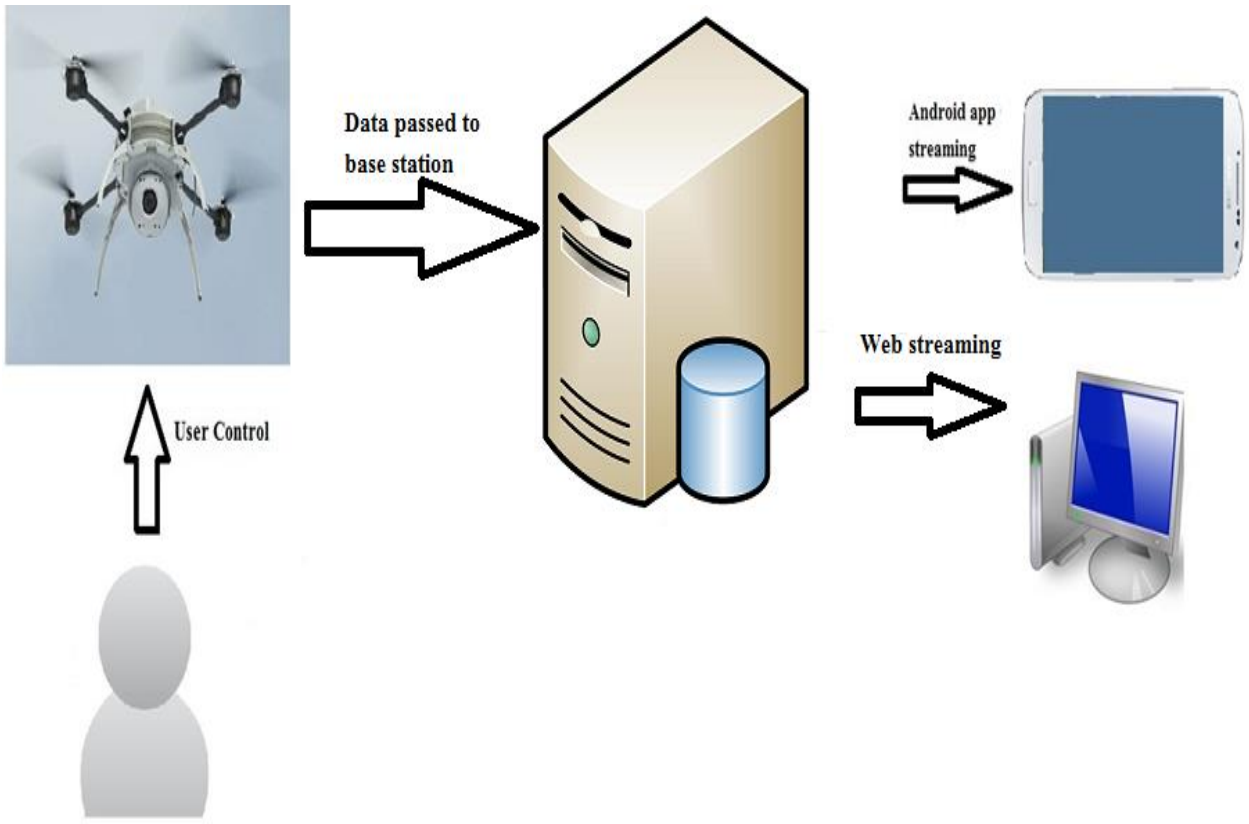

Figure 1-1: Product Concept

1.4 Scope of Testing

There are different types of testing criteria and they are evaluated according to their effect on the project. Some of the testing that will be carried out during the testing phase of the project will be as follows:

- Unit testing
- Integration testing
- Component testing
- System validation

The test results are categorized according to their effect on the project functionality and the categories are as follows:

- High- affects system performance and functioning to the fullest extent, may also include security concerns.
- Medium- affects the system performance, but the overall system still functions.
- Low – doesn't the affect the performance and functioning, but might cause minor bugs.

The testing of the system will be done in a controlled environment. The test will be done in the room which will be a big enough to fly around up to the height of 10 feet. The software testing will be done in a lab room and integration testing will also be performed in the lab room. All the safety measures will be followed while testing. The small module will be tested in the lab room to determine they are not defect able and will not effect in system development. The final testing will be done by flying in a big field where we will be able to fly around height of 50 feet and the battery power will be tested in the same process. The usability will be tested by asking a very new user to run our system by using our user manuals.

2. References

This section provides the over view of the references taken for the system test plan. The references for system test plan prepared from already established documents such as System Requirement Specification (SRS), Architectural Design Specification (ADS) and Detail Design Specification (DDS).The information from these established documents will be the basis for the testing strategy presented in the System Test Plan. Below is the subsection for each document.

2.1 System Specification Requirement

2.1.1 Customer Requirement

SRS No.	Requirement	Description	Priority
3.1	Flight Trajectory and Height	The system shall include vehicle that has the ability to fly forward and hover if necessary as directed in a specified trajectory and height. The vehicle shall include a mechanism to fly and land it safely when needed. The vehicle weight should not exceed more than 6 lbs. and be able to hold camera (wt around 2lbs).The propeller shall be 8" to 12" and easy to fly.	1-Critical
3.2	Capturing Live Video and images	The system shall have camera that records the videos and save it in the database for 5 days and be able to get images from those videos. The system shall give option for the user to view the live streaming videos, recorded videos, and still images through web browsers and Android phone. The streaming should be done in real time. All recorded images and videos will be saved in the databases automatically. The streaming will be done through server from base stations.	1 – Critical
3.3	Notification System	The system shall have a capability to send an email notification and text message to the admin of the system and the users of the system. The system will send out notifications if it senses any irregular activities while in operation.	1- Critical
3.4	Human Override Capability	The administrator shall be able to override autopilot system of the drone. After doing so, the user can control the drone using a remote control and will have an option to switch back to auto pilot.	1 - Critical

3.5	Energy Detection Capability	"The Neighborhood Patrol Drone will have a battery level detection system. This is so that when the battery level goes below a specified amount, the Neighborhood Patrol Drone can auto land to prevent it from crashing. The battery level will be monitored by the system constantly. Admin of the system will be able to view battery level through web application and the system will also have a battery level indicator."	2 – High
3.6	The Vehicle Detection System	The system shall be able to identify vehicles such as mail delivery vehicles, jeeps, cars, bikes, and trucks. The system will have information about the vehicles, mainly dimension of the vehicle which will be saved in the database by system administrator. This data will be used by the drone in order to make distinguish between known and unknown types of vehicles. The comparisons will be done using dimension of the vehicle.	3 – Moderate
3.7	Registration	The admin can add new user to the system as a local user who can view live streaming videos, captured still images and videos, and get notification.	1 – Critical
3.8	Log In/Log Out	The admin and user can log into the web application and android application to view the live streaming videos, captured still images and videos.	1 – Critical
3.9	Battery Power	The vehicle must fly for at least half an hour before needing to recharge.	1 – Critical

Table 2-1: Customer Requirement

2.1.2 Packaging Requirement

SRS No.	Requirement	Description	Priority
4.1	Drone	The package shall include pre-assembled drone, Go-pro camera and rechargeable batteries for Go-pro and drone, remote controller. The rechargeable battery will be included separately in the package to conserve the energy of the battery and to avoid any possible short circuit in the system. The weight of the drone will be at least 6 lb.	1-Critical
4.2	Android Application	Android application will be released on the Google Play as a free downloads to watch captured video and pictures for the users.	1 – Critical
4.3	Web Application	A website will be created to access videos and pictures captured by the drone for the user.	1 – Critical
4.4	User manual	The final product will have a user manual printed in English. The user manual will include information on how to assemble the device as well as installation software for the system. It will have complete information about the specifications and features of the product.	1 – Critical
4.5	Base station	The base station will consists of a computer and a running server which will be used for image processing and broadcasting videos and images to the web and android applications. The base station will also works as a final resting place and charging station for the drone.	1 – Critical
4.6	Source Code Disk	A source code disk will be included in the package. This disk will contain all the source code for the system and digital version of user manual.	1 – Critical

Table 2-2: Packaging Requirement

2.1.3 Performance Requirements

SRS No.	Requirement	Description	Priority
5.1	Video/Photo Streaming and Storage	System should be able stream uninterrupted video and save captured videos and pictures in databases for five days. Database will have maximum size of 1TB.	1- Critical
5.2	Video Streaming Latency	While streaming live videos there will be a latency of at least 5 seconds.	2 – High
5.3	System Response Time	The system will have a fast user interface. There will be a delay of maximum 5 seconds.	3 - Moderate

Table 2-3: Performance Requirement

2.1.4 Safety Requirements

SRS No.	Requirement	Description	Priority
6.1	Rotor Blades	System will have 4 rotor blades, when in operation it may injure any person or an animal if came in contact.	1 – Critical
6.2	Auto Land System Failure	The vehicle will be able to auto land when it detects low battery power. But, if an error arises in auto land functionality, the vehicle may crash and hurt someone.	1 – Critical
6.3	Drone Speed	System should be able to fly with top speed of at least five mph and should be able reduce its speed to zero in order to hover.	1 – Critical
6.4	Drone Height	The maximum flying height of the drone will not exceed 30 feet and the lowest will be 20 feet.	1 – Critical
6.5	Safety Guide	Safety guide will be provided, which will have detail description of safety measurements that needs to be followed while operating the drone.	2 – High
6.6	Error in GPS reception	While flying, if the system loses its GPS reception, the system will auto land. And the system will notify the system administrator with its last known location so as to ease the manual retrieve process.	2 - High

Table 2-4: Safety Requirement

2.1.5 Maintenance and Support Requirements

SRS No.	Requirement	Description	Priority
7.1	Patrol Crusaders shall fix software errors	Software error in both surveillance system and in drone may surface during the time frame of drone operation. Patrol Crusaders will provide CD-ROM which will have software to fix any software error and return system to original setting.	2 - High
7.2	Patrol Crusaders shall fix all hardware failure	Some hardware may fail during the period of system use. Patrol crusaders will provide all required documents which will have information about maintenance of the system.	2 - High
7.3	Troubleshooting Guide	The team will provide all the details of system configuration and maintenance procedure to the user as a CD ROM disk and written troubleshooting guide. It will consist of all the required material for hardware and software reconfiguration. The data recovery procedure is also provided in a guide if any data loss occurred during the products usage.	1 - Critical

Table 2-5: Maintenance and Support Requirement

2.1.6 Other Requirements

SRS No.	Requirement	Description	Priority
8.1	System Operation	In order to operate the system, some legal issues need to be taken into consideration that is why the system will not be operated outside specified area.	1 – Critical
8.2	Documentation	All documents and measurements shall be done in U.S. standard.	3 – Moderate
8.3	Water Proofing	The vehicle shall be prevented from water in order to prevent from damaging its components. The water proofing is to ensure that the vehicle can be brought back to the base station if it is raining.	2 – High
8.4	OS Support	The user interface software shall be designed to run on windows and android applications.	2 – High
8.5	Initial Set Up	System will be preassembled. User will only need to download application for phone and download surveillance software in the computer and go through provided user manual to use the system. To access the system through web or android application, user must login using login information provided by the patrol crusader or the system administrator.	2 – High
8.6	FAA Regulation	To operate drone lawfully, user will have to obtain permission from FAA.	1- Critical

Table 2-6: Other Requirement

2.2 Architecture Design Specification

The Architectural design will describe the architecture for the Neighborhood Patrol Drone (NPD). This document will provide the system's architecture, principle guidelines, layers, subsystems, dependencies, and testing considerations. This section will include product concept, scope, and key requirements**.**

2.2.1 Architecture Design Diagram

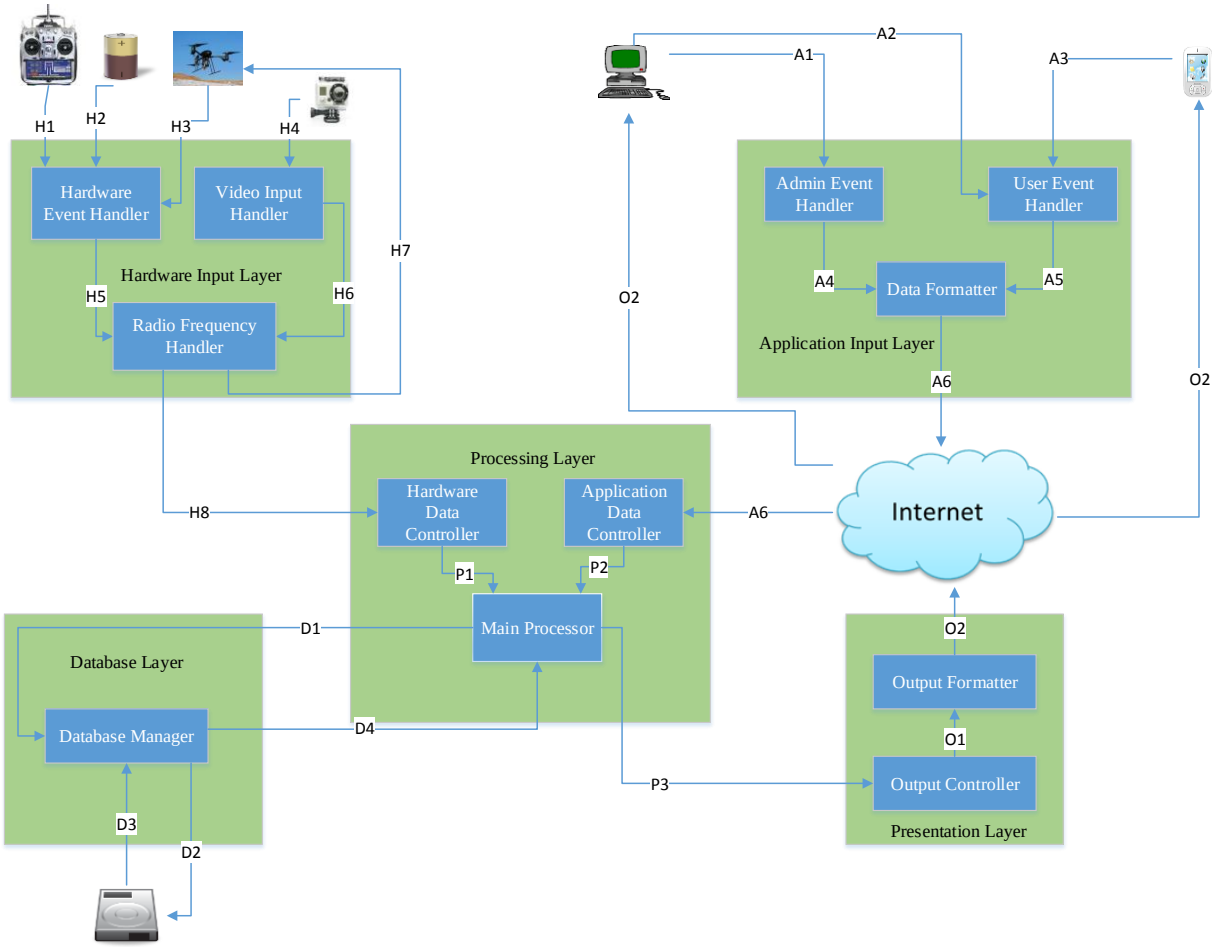

Figure 2-1: Architecture Design Diagram

2.2.2 Data Flow Definition

Data Element ID	Description	Source	Sink
A1	Admin enters any input into the Web application or requests functionality from the application.	Admin	Admin Event Handler
A2	User enters any input into the web application or requests functionality from the application.	User	User Event Handler
A3	User enters any input into the Android™ application or requests functionality from the application	User	User Event Handler
A4	An event from the admin is processed and sent to the Data Formatter to format the request into information usable by another subsystem.	Admin Event Handler	Data Formatter
A5	An event from the user is processed and sent to the Data Formatter to format the request into information usable by another subsystem.	User Event Handler	Data Formatter
A6.1	After the message has been formatted it is passed using the internet.	Data Formatter	Internet
A6.2	The Internet passes the information it received from Data formatter to the Application Data Controller.	Internet	Application Data Controller
D1	The fully processed information has will be passed to the Database Manager in order to get ready to be stored.	Main Processor	Database Manager
D2	The formatted data will be passed to the Database (i.e. scan disk, hard drive) which will store the information.	Database Manager	Database (hard drive)
D3	The needed stored data is requested from the Database (i.e. scan disk, hard drive) and is formatted into data that is readable by the system.	Database (hard drive)	Database Manager
D4	When stored data is requested it is passed from the Database Manager to the Main Processor.	Database Manager	Main Processor

H1	The Hardware Event Handler will listen the input in the form of a button press and then pass the appropriate information.	Controller	Hardware Event Handler
H2	The Hardware Event Handler will get signal from battery about its power.	Battery	Hardware Event Handler
H3	The Hardware Event Handler will get information about drone movement from the Drone (Auto pilot module).	Drone(Auto pilot module)	Hardware Event Handler
H4	The Video Input Handler will get video frame as input from the video camera.	Video Camera	Video Input Handler
H5	The hardware event that has been occurred is transferred to the Radio Frequency Handler either process the data or pass it to the system for high level processing.	Hardware Event Handler	Radio Frequency Handler
H6	The video event that has been occurred is transferred to the Radio Frequency Handler which will pass it to the Hardware Data Controller.	Video Input Handler	Radio Frequency Handler
H7	The processing is done to the command it received from the controller and passed to the drone.	Radio Frequency Handler	Drone (auto pilot module)
H8	The video event and hardware event that has been occurred is relayed to the Hardware Data Controller for action to be taken by the system.	Radio Frequency Handler	Hardware Data Controller
O1	The output data is passed to the Output Formatter so that it can be put in the correct format.	Output Controller	Output Formatter
O2.1	The formatted data is passed via the internet.	Output Formatter	Internet
O2.2	The internet will act like a bridge and pass the output data to the admin so that they can view the output information, either on an android app or the web application.	Internet	Admin
O2.3	The internet will act like a bridge and pass the output data to the user so that they can view the output	Internet	User

	information, either an android app or the web application.		
P1	Once hardware data has been received and analyzed, it is passed to the Main Processor for performing the requested action.	Hardware Input Controller	Main Processor
P2	Once the application data has been received and analyzed, it is passed to the Main Processor for performing the requested action.	Application Data Controller	Main Processor
P3	The processed information will be passed to the Output Controller so that it can be output.	Main Processor	Output Controller

Table 2-7: Data Flow Definition

2.2.3 Layer Definition

Hardware Layer: The purpose of this layer is to gather the data from the hardware component of the system such as drone (Pilot Module), video camera, battery, and controller. The data from the hardware parts will be collected by respective subsystem inside the Hardware Input Layer and will send it to the Processing Input Layer.

Application Layer: The purpose of this layer is to gather the input data from user via web application and android app .This layer contains all the business logic such that the gathered data are formatted through respective subsystems and send it to the Processing Layer.

Processing Input Layer: The purpose of this layer is to accept the formatted data sent from Hardware Input Layer and Application Input Layer, and analyze it. After the data has been analyzed it is then sent to a main processing component where it is further processed and the appropriate action will be generated. This layer also contains a component to deal with API requests to the Internet as well as their responses.

Database Management Layer: This layer will store the analyzed data received from the subsystem of processing input layer i.e. main processing component. The subsystems in this layer manage all data and store it to its designated place. After receiving a formatted query, the database sends formatted data back to the Processing Layer.

Presentation Layer: This layer will display the information to the user via drone, admin home page or user home page. Data to be displayed is sent from the Processing Layer to the Presentation Layer and is then transmitted to the respective output formatter based on the data received.

2.2.4 Requirements Mapping

The requirements mapping takes every top level requirement of our system and maps it to the layer in which that requirement is met. Thus it shows how data flows for each of the requirements. This mapping also allows us to identify test cases for different functionality for each layer.

No.	Requirements	Application Input	Hardware Input	Processing	Database	Presentation
3.1	Flight Trajectory and Height		√	√		
3.2	Capturing Live Video and images		√			
3.3	Notification System			√		√
3.4	Human Override Capability		√	√		√
3.5	Energy Detection Capability		√	√		
3.7	Registration	√		√		√
3.8	Log In/Log Out	√		√		√
3.9	Battery Power		√	√		√
4.5	Base station	√	√	√	√	√

Table 2-8: Requirement Mapping

2.3 Detailed Design Specification

Detailed Design Specification document will provide a bottom-level or detail analysis of the Architecture Design Specification document for NPD (Neighborhood Patrol Drone). The NPD system architecture consists of five layers and their subsystems. These subsystems are being expanded to the module level in this document in order to give specific information about the module like their inputs and outputs, data types and flows, interfaces with other modules, external dependencies, and pseudo code for the main functionality of each module.

2.3.1 Module Overview

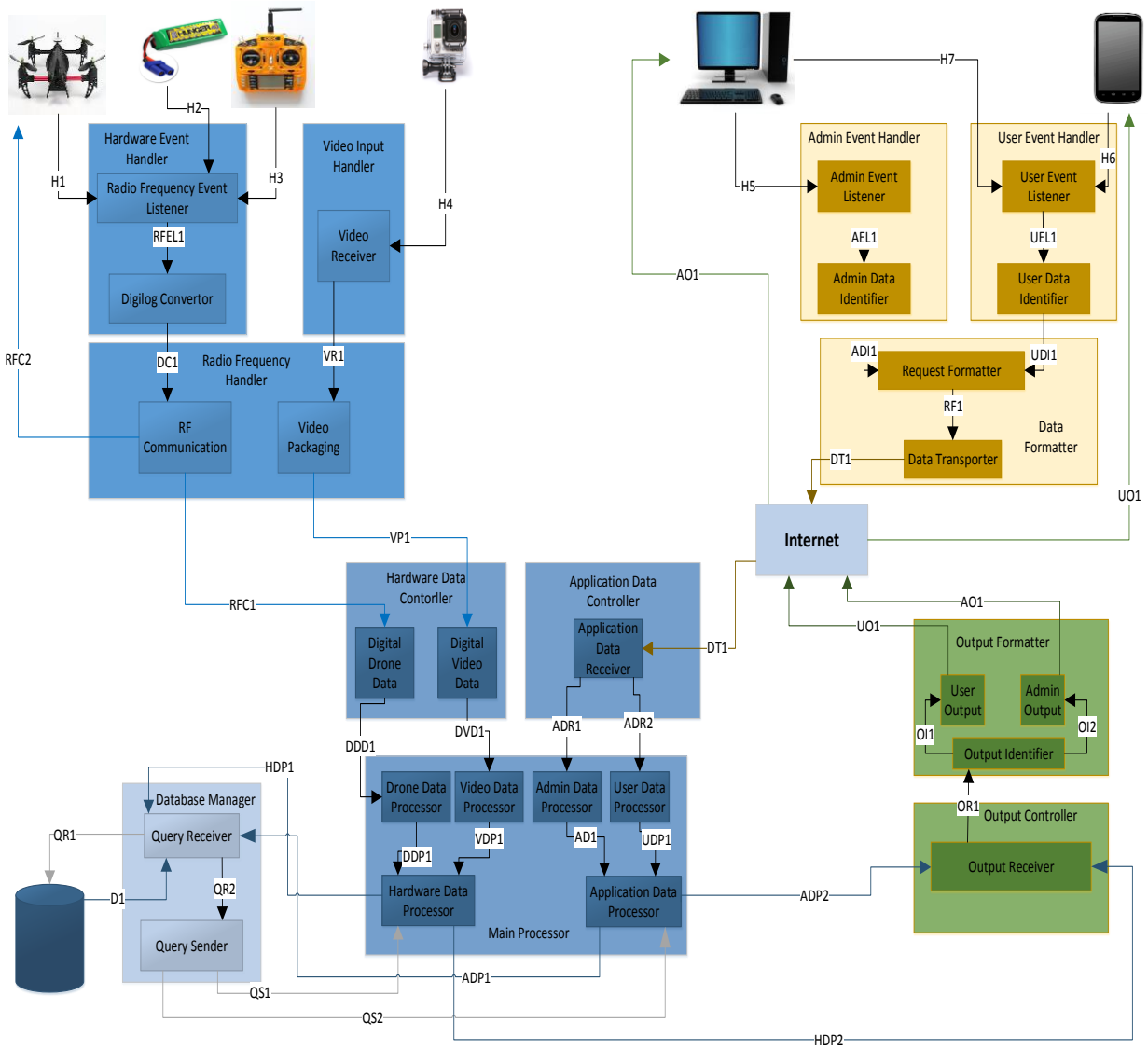

Figure 2-2: Module Overview

Data Element	Data Type	Description
H1	Drone Position Information	Drone height, location, speed
H2	Controller Input	Autopilot On Off
H3	Battery Voltage	Battery power of the drone
H4	Video stream	Recorded video data
RFEL1	Analog Data	Drone, controller, battery data and source
VR1	Digital Video Data	Video data and its time stamp
DC1	Digital Data	Analog data converted to Digital
RFC1	Digital Data	Digital Data, Drone and Battery
RFC2	Controller response analog	Digital Data Converted to analog for sending message to the drone
VP1	Digital Video Data	Digital Video data with time stamp
H5	Admin Input	Admin Interaction with NPD
H6/H7	User Input	User Interaction with NPD
AEL1	Java Event ID	Event ID of Admin interaction
ADI1	Java Object	Java object created from event
UEL1	Java Event ID	Event ID of user interaction
UDI1	Java Object	Java object created from event
RF1	JSON Object	Java object converted to JSON
DT1	TCP/IP Packet	Network packet containing source, destination, and data
DDD1	Digital Data	Digital Data, Battery power and Drone location with time stamp
DVD1	Digital Video Data	Digital Video data with time stamp
ADR1	JSON Object	JSON Object received via network destined for Admin Data Processor
ADR2	JSON Object	JSON Object received via network destined for User Data Processor
DDP1	Digital Data From Drone	Digital Data, Battery power and Drone location with time stamp
VDP1	Video Data In Bits	Digital Data Converted to the bits to save in database
AD1	Command Admin Request Object	Command Request converted from JSON
UDP1	Command User Request Object	Command Request converted from JSON
HDP1	SQL Query	Data Request Object converted to SQL Query (Hardware Data)
HDP2	JSON Object	JSON-formatted command sent to Application

ADP1	SQL Query	Data Request Object converted to SQL Query (Application Data)
ADP2	JSON Object	JSON-formatted command sent to Application
QR1	Read/Write Request	Stores/reads SQL Query data to/from storage
QR2	SQL Response	Retrieved data formatted into SQL
D1	File Bytes	File or data bytes retrieved from storage
QS1	Data Response Object	SQL Response converted to Data Response Object for Hardware Objects
QS2	Data Response Object	SQL Response converted to Data Response Object for Application requests
OR1	JSON Object	JSON Object to format into user response
OI1	Java Object	Java object created from JSON
OI2	Java Object	Java object created from JSON
UO1	Java Object	Response to the user request
UO2	Display Change Info	Changes to display interpreted form Java object
AO1	Java Object	Response to the Admin request
AO2	Display Change Info	Changes to display interpreted form Java object

Table 2-9: Module Data Flow

2.3.2 Requirement Traceability Matrix

2.3.2.1 Requirement matrix for Application Input, Hardware Input, and Database Layer

Requirements	Admin Event Listener	Admin Data Identifier	User Event Listener	User Data Identifier	Request Formatter	Data Transporter	Request Formatter	Radio Frequency	DigiLog Convertor	Video Receiver	Drone Data Identifier	Video Formatter	Query Receiver	Query Sender
3.1 Flight Trajectory and Height								X	X		X			
3.2 Capturing Live Video and images										X		X	X	X
3.3 Notification System														
3.4 Human Override Capability								X	X		X			
3.5 Energy Detection Capability								X	X		X			
3.7 Registration	X	X	X	X	X	X	X						X	X
3.8 Log In/Log Out	X	X	X	X	X	X	X							
3.9 Battery Power								X	X		X			
4.5 Base station														
5.2 Video Streaming Latency										X		X	X	X
5.3 System Response Time								X	X		X			

Table 2-10: Requirement Traceability matrix for Application Input, Hardware Input, and Database Layer

2.3.2.2 Requirement Traceability matrix for Processing Layer and Presentation Layer

Requirements	Digital Drone Data	Digital Video Data	Data Receiver	Drone Data Processor	Video Data Processor	Admin Data Processor	User Data Processor	Hardware Data	Application Data	Output Receiver	Output Identifier	User Output	Admin Output
3.1 Flight Trajectory and Height	X							X					X
3.2 Capturing Live Video and images		X			X			X		X	X	X	X
3.3 Notification System								X		X	X	X	X
3.4 Human Override Capability													
3.5 Energy Detection Capability	X			X				X		X	X		X
3.7 Registration			X						X	X	X	X	X
3.8 Log In/Log Out			X						X	X	X	X	X
3.9 Battery Power	X			X					X	X	X	X	X
4.5 Base station	X	X	X	X	X	X	X	X	X				
5.2 Video Streaming Latency		X			X			X		X	X	X	X
5.3 System Response Time													

Table 2-11: Requirement Traceability matrix for Processing Layer and Presentation Layer

3. Test Item

This section will give the brief view of the action that will be used to test NPD and its functionality. The first step of the testing is unit test where all the module of the system will be tested. When an error or fault is detected, it is fixed and then we will move to the component testing where all the subsystem is tested. After the component test, integrated testing is done. In integrated testing each layer of the system is tested for the correctness. Each component of the hardware is tested thoroughly by our hardware lead for the best result.

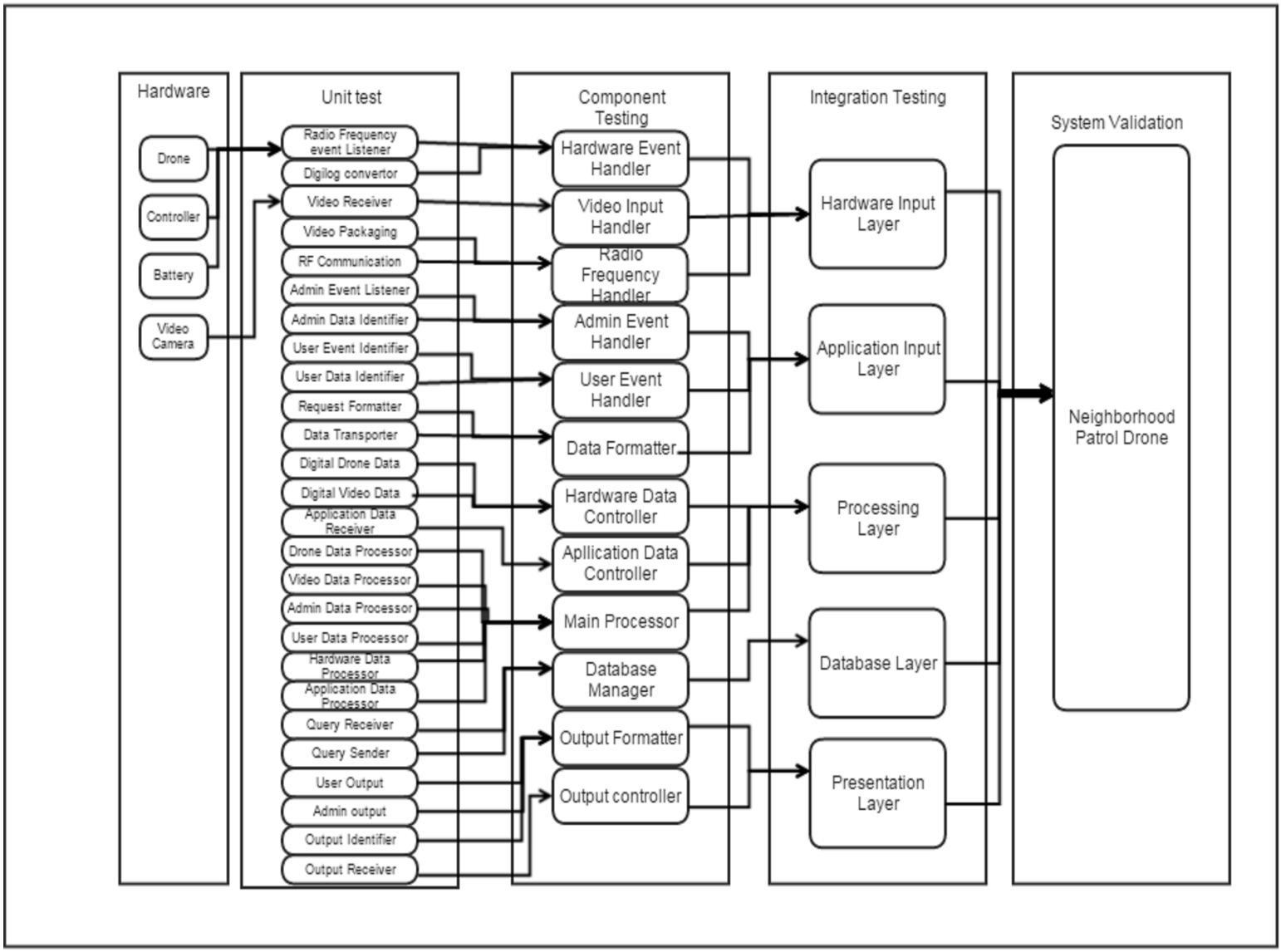

Figure 3-1: Testing composition diagram

3.1 Hardware Test

ID	Hardware	Input	Output	Test	Requirement
UH1	Drone	Height, speed, GPS locations	The drone position	Test the drone by flying it in the given position, speed, the height and hover if necessary.	3.1
UH2	Battery	Battery Voltage	Power reading	Test the battery by flying the drone for at least for 0.25 hrs	3.9
UH3	Controller	Controller input	Autopilot On/Off	Test the auto pilot mode by flying in auto pilot mode Test stabilize mode by flying in controlled manner. Test the control services by flying drone and maneuvering in different positions like sides, upward, backward front etc.	3.4
UH4	Camera	Video stream	Record the videos	Test the camera by recording the videos.	3.2

Table 3-1: Hardware Tests

3.2 Unit Test

3.2.1 Hardware event handler sub layer

ID	Module/ Unit	Input	Output	Test	Priority
UHEH1	Radio Frequency event Listener	Controller input, Battery voltage, Drone position	The drone position and battery voltage and signals.	Test is performed by sending the data from the drone, controller and battery to the module.	High
UHEH2	Digilog converter	Sorted input from controller, battery or drone along with identification of the source of input	Digital data converted from analog data	Test is performed by sending the sorted various analog data and digital data.	High

Table 3-2: Hardware event handler unit test

3.2.2 Video Input Handler

ID	Module/Unit	Input	Output	Test	Priority
UVIH1	Video Receiver	Video stream from the camera of drone.	Digital video Data.	Test is performed by sending the video data from the camera.	High

Table 3-3: Video input handler unit test

3.2.3 Radio Frequency Handler sub layer:

ID	Module/Unit	Input	Output	Test	Priority
URFH1	RF communication	Digital data input from a specified piece of hardware	Signal to the Controller.	Test is performed by sending the controller input. Test is performed by receiving the controller input back to the drone.	High
URFH2	Video Packaging	Digital video data	Packets of digital video data.	Test is performed by sending the package of video data from the video receiver.	High

Table 3-4: Radio frequency handler unit test.

3.2.4 Admin Event Handler sub layer:

ID	Module/Unit	Input	Output	Test	Priority
UAEH1	Admin event Listener	Admin event Id (on click)	Admin page.	Test is performed by clicking the log in button and entering the admin's page.	High
UAEH2	Admin Data Identifier	Admin input object (java class object)	Boolean value.	Test is performed by entering the admin's credentials.	High

Table 3-5: Admin event handler unit test

3.2.5 User event Handler sub Layer:

ID	Module/Unit	Input	Output	Test	Priority
UHEH1	User Event Listener	User event Id (on click)	User's page	Test is performed by clicking the log on button.	High
UHEH2	User Data Identifier	User Input object(Java class object)	Boolean value.	Test is performed by entering the user's username and password.	High

Table 3-6: User event handler unit test

3.2.6 Data formatter sub layer:

ID	Module/Unit	Input	Output	Test	Priority
UDF1	Request Formatter	User identifier data (java class object)	The requested event and success message.	Test is performed by entering different data into the android/web page.	High
UDF2	Data Transporter	Data object (JSON)	Users request success message.	This module will send JASON object. Test will be performed to insure the object contains all the information that needs to be passed.	High

Table 3-7: Data formatter unit test

3.2.7 Hardware Data Controller subsystem

ID	Module/Unit	Input	Output	Test	Priority
UHD1	Digital drone data	Drone's location, battery level	The digital data packets.	The drone data such as location and the battery status will be sending.	High
UHD2	Digital Video data	Video signals.	Video data packets.	Test will be performed by sending the video feeds.	High

Table 3-8: Hardware data controller unit test

3.2.8 Application Data Controller subsystem

ID	Module/Unit	Input	Output	Test	Priority
UA1	Application data receiver	User request, Admin data as a packets of JASON object.	JASON object	Test is performed by sending the different request.	High

Table 3-9: Application data controller unit test

3.2.9 Main processor subsystem

ID	Module/Unit	Input	Output	Test	Priority
UMP1	Drone data processor	Drone's location ,battery level	Digital Drone Data.	Test is performed by sending the digital data of drone.	High
UMP2	Video drone data processor	Digital video data	Digital video data	Test is performed by sending the digital format of the videos.	High
UMP3	Admin data processor	Admin request data	Command Admin request object.	Test is performed by sending the admin's request such as adding the user or viewing the video.	High
UMP4	User data processor	User request data	Command User request object.	Test is performed by sending the user's request such as viewing video.	High
UMP5	Application data processor	User and Admin requests.	SQL query	Test is performed by sending the log in request/viewing video/editing user.	High
UMP6	Hardware data processor	Digital Drone Data Video data in the bits streams	SQL query	Test is performed by sending data related to drone.	High

Table 3-10: Main processor unit test

3.2.10 Database manager sub layer

ID	Module/Unit	Input	Output	Test	priority
UDM1	Query Receiver	SQL Queries	Boolean values	Test is performed by sending queries to store videos, add /edit user and authentication of admin.	High
UDM2	Query Sender	Boolean values	Result of the queries.	Test is performed by receiving queries that will help to retrieve the data from database.	High

Table 3-11: Database manager unit test

3.2.11 Output formatter sub layer:

ID	Module/Unit	Input	Output	Test	Priority
UOF1	User output	User data such as video and user info (Java object)	User's page in web/android app.	Test is performed by sending a java objects into the function. The android app test is also performed by sending a java objects into the function.	High
UOF2	Admin output	Admin data such as video, user's credentials (Java object)	Admin's page in web application.	Test is performed by sending a java object into the functions.	High
UOF3	Output Identifier	Different data for user (Java object)	Admin's data and User data.	Test is performed by sending the various java objects.	High

Table 3-12: Output formatter unit test

3.2.12 Output controller

ID	Module/Unit	Input	Output	Test	Priority
UOC1	Output Receiver	Data related to hardware and application in the form of JSON object	Formatted data as java object.	Test is performed by sending data such and hardware data (location, position of drone) and the user's info.	High

Table 3-13: Output controller unit test

3.3 Component testing

3.3.1 Hardware sub-system

ID	Subsystem	Input	Output	Test	Priority
CH1	Hardware Event Handler	Data from drone, battery, controller.	Analog data.	Test is performed by sending the various data from drone, battery and controller as a radio frequency and the subsystem will format the analog data to digital.	High
CH2	Video Input Handler	Video Package	Formatted digital video data.	Test is performed by sending a video from the camera attached to the drone and this system will format the video and send it to the next subsystem for further action.	High
CH3	Radio Frequency Handler	Radio Frequency	Converted data from analog to digital.	Test is performed by sending the radio frequency data from the hardware on the drone.	High

Table 3-14: Hardware layer subsystem component testing.

3.3.2 Application Sub-system

ID	Subsystem	Input	Output	Test	Priority
CA1	Admin Event Handler	Administrator's input data	Java Object	Test is performed by entering the admin's credentials. Test is perform byclicking the various admin's functions.	High
CA2	User Event Handler	User's input data	Java object.	Test is performed by entering the user's credentials and Test is performed by clicking the various user's functions	High
CA3	Data Formatter	Event data generated by android application or web application.	Formatted data as JASON object.	Test is performed by entering the user's credentials.	High

Table 3-15: Application layer subsystem component testing.

3.3.3 Processing layer sub-system

ID	Sub-system	Input	Output	Test	Priority
CP1	Hardware Data Controller	Formatted radio frequency data	Drone data.	Test is performed by sending the various formatted radio frequency data in order to identify the action that a system needs to perform.	High
CP2	Application Data Controller	Formatted Information /Action from user	Application data.	Test is performed by sending the various formatted application data in order to identify the action to be performed.	High
CP3	Main Processor	Formatted hardware data and the Application data	Communication with database or API handler	Test is performed by sending the various hardware and application data to communicate with database and the API handler.	High

Table 3-16: Processing layer subsystem component testing.

3.3.4 Database sub system

ID	Sub-system	Input	Output	Test	Priority
CD1	Database Manager	Queries	Stored data and Boolean values	Test is performed by generating the various queries to store/update/delete/check the data.	High

Table 3-17: Database layer subsystem component testing.

3.3.5 Presentation layer subsystem

ID	Subsystem	Input	Output	Test	Priority
CO1	Output formatter	JASON objects.	Displaying the requested action by user or admin (java object).	Test is performed by sending the various data of user and admin.	High
CO2	Output controller	Result of the user request as packet.	JASON objects.	Test is performed by passing the various data such as hardware data and the application and data.	High

Table 3-18: Database layer subsystem component testing.

3.4 Integration testing

ID	Layers	Input	Output	Test	Priority
I1	Hardware Layer	Analog Hardware data	Converted digital data.	Test is performed by providing a test hardware data.	High
I2	Application Layer	Application data	JASON object the requested application data	Test is performed by providing a test application data.	High
I3	Processing Layer	Pre-Processed hardware data and application data	Processed application and hardware data	Test is performed by providing a testing data	High
I4	Database Layer	Queries	Stored data	Test is performed by providing testing queries.	High
I5	Presentation Layer	Application data and videos	Graphical display of the web application and android application	Test is performed by clicking the various actions on the interface of web application or android application.	High

Table 3-19: Integration test

3.5 System validation

ID	System Test	Requirement addressed	Input	Expected Output	Priority
S1	Admin's page	4.5,3.8,4.3,3.7,3.5	Admin enters their credentials	Admin's page is displayed where they can add/edit/delete the user, view live or stored video	High
S2	User's page	4.2,4.3,3.8	User enter their credentials	User's page is displayed where they can view their information and stored video in android application or web application.	High
S3	Drone's performance	3.1, 3.2,3.4,3.9,8.6	Location, height ,position is given to drone to fly	Specific height, speed and position is given to the drone to fly and capture the video of the neighborhood.	High
S4	Ease of use	4.4,3.4,7.3	User is given a drone to fly	User is able to easily fly the drone and view all the stored data.	Medium

Table 3-20: System validation test

4. Risk

4.1 Overview

This section will discuss the risk that can be encountered during the testing of the system. Various tests will be performed in order to get a better functioning system. While trying to build a better system we might encounter with loads of risk and if the risk were not handles properly then it can lead to the failure of the system. However, since we are aware of the risk that we might encounter while building the system, we will carefully observe every risk and overcome the hindrance while building our system.

4.2 Risk table

Following is the table of the risk that we might encounter while testing our system. The risk is listed, along with potential impact on the system, severity level, and a strategy to avoid or minimize the risk.

ID	Risk	Impact	Severity	Mitigation Impact
1	Hardware Failure	Hardware device fail due work properly or not durable product	High	Replace the damage or non-working parts or get the parts from the credible vendor.
2	Third Party application	NPD is using some third party software for auto flight pilot module. While editing and adding more functions, it can tamper other functions of the system.	Medium	While editing or adding the function in third party's software we will keep back up of the original one.
3	Software Bug	Faulty information and data is sent to the other layers.	Medium	Regression testing will be done to identify and fix the bug.
4	Incomplete Testing	Incomplete testing will help in mushrooming the fault and errors.	Medium	All tests will be divided among the team member to avoid such risk.

Table 4-1: Risk table

5. Features to be Tested

This section will describe all the features and the requirement to be tested in the Neighborhood Drone Patrolling (NPD). Each feature mentioned here will undergo testing in order to verify the requirement has been satisfied.

5.1 Customer Requirement

5.1.1 Flight Trajectory and Height

Description: The drone will fly forward and hover if necessary as directed in a specified trajectory and height. The vehicle will fly and land it safely when needed.

Test Approach: Team will fly the drone at a Specific height and speed .We will send a command for the safely land and fly the drone in order to avoid the physical damage of the system.

5.1.2 Capturing Live Video and images

Description: The system will have camera that records the videos and save it in the database for 5 days and be able to get images from those videos. Admin will have the option to view the live streaming videos, recorded videos, and still images through web browsers and Android phone. The streaming should be done in real time. All recorded images and videos will be saved in the databases automatically. The streaming will be done through server from base stations.

Test Approach: The team will fly the drone neighborhood and a video will be recorded meanwhile. The live streaming of the video will be broadcasted in the base station where a team will log in with the help of admin's credentials. Videos will be stored in database and stored video will retrieve from data base for viewing.

5.1.3 Human Override Capability

Description: The administrator shall be able to override autopilot system of the drone. After doing so, the user can control the drone using a remote control and will have an option to switch back to auto pilot.

Test Approach: Team will take control of the drone by sending the command for human override. A controller will be used to fly the drone as per the intended of the team member at the intended height, speed and location.

5.1.4 Energy Detection Capability

Description: The Neighborhood Patrol Drone will have a battery level detection system in the base station. This is so that when the battery level goes below a specified amount, the Neighborhood Patrol Drone can be control user to prevent it from crashing. The battery level will be monitored by the system constantly. Admin of the system will be able to view battery level through web application and the system will also have a battery level indicator.

Test approach: Light signal will be observed by the team members to verify energy detection cabability.

5.1.5 The Vehicle Detection System

Description: The system will be able to identify vehicles such as mail delivery vehicles, jeeps, cars, bikes, and trucks. The system will have information about the vehicles, mainly dimension of the vehicle which will be saved in the database by system administrator. This data will be used by the drone in order to make distinguish between known and unknown types of vehicles. The comparisons will be done using dimension of the vehicle.

Test Approach: Team will fly a drone around a neighborhood and an unknown vehicle will be parked in a neighborhood for more than hour and let the drone verify the unknown vehicle. When the drone will verify the unknown vehicle it will send the alert to the base station.

5.1.6 Battery Power

Description: The battery will supply power to the system for 6-10 mins before needing to recharge.

Test Approach: Drone will be flown for 6-10 mins to test battery performance.

5.1.7 Registration

Description: The admin can add new user to the system as a local user who can view live streaming videos, captured still images and videos, and get notification.

Test Approach: Team will log in as an admin and will try to add other user to view the stored video.

5.1.8 Log In/Log Out

Description: The admin and user can log into the web application and android application to view the live streaming videos, captured still images and videos.

Test Approach: Team will try to log-in in the android application or a website as a user and admin using the admin's or user's login name and the password.

5.2 Packaging Requirement

5.2.1 Android Application

Description: Android application will be released on the Google Play as a free downloads to watch captured video and pictures for the users.

Test approach: Team will try to download the android application on their android phone and log in as a user or an admin. All the functions in the android application will be tested by touching on the icons.

5.2.2 Web Application

Description: A website will be created to access videos and pictures captured by the drone for the user.

Test approach: Team will enter the website in the Google chrome and try to log in into the website. All the functions in the web application will be tested by clicking on each option.

5.2.3 Base station

Description: The base station will consists of a computer and a running server which will be used for image processing and broadcasting videos and images to the web and android applications. The base station will also works as a final resting place and charging station for the drone.

Test Approach: A drone will be charged in the base station and the live video will be watched in the base station using the admin's username and the password. The alert of the unknown vehicle will be detected in the base station.

5.2.4 System Response Time

Description: The system will have a fast user interface. There will be a delay of maximum 5 seconds.

Test Approach: Different commands will be executed from the android application or web application. The time it takes for system to respond to the commands will be measured and verified to be within 5 seconds.

5.2.5 User manual

Description: The final product will have a user manual printed in English. The user manual will include information on how to assemble the device as well as installation software for the system. It will have complete information about the specifications and features of the product.

Test Approach: User manual, containing product features, installation steps and maintenance and troubleshooting information, will be provided to user of the NPD and verified the usefulness of the user manual.

5.2.6 Source Code Disk

Description: A source code disk will be included in the package. This disk will contain all the source code for the system and digital version of user manual.

Test Approach: A source code disk containing the source code for the system and digital version of user manual will be provided to the NPD user and verifies the usefulness of the source code disk.

5.2.7 Connecting Cables

Description: Power cable and Ethernet cable will be included in the final packaging. Their intended purpose is to be used with the central control unit.

Reason: This requirement will not be tested because the cables are expected to be in full-working condition upon purchase.

5.3 Performance Requirements

5.3.1 Video/Photo Streaming and Storage

Description: System should be able stream uninterrupted video and save captured videos and pictures in databases for five days. Database will have maximum size of 1TB.

Test Approach: Team will fly the drone around the neighborhood and capture the video and store the complete package of video in the database for five days. The stored video will be viewed for 5 days.

5.3.2 Video Streaming Latency

Description: While streaming live videos there will be a latency of at least 5 seconds.

Test Approach: Team will watch the live video of captured by the camera attached to the drone while patrolling the neighborhood in the base station and record the time latency and verify is it is of at least 5 second or not.

5.3.3 System Response Time

Description: The system will have a fast user interface. There will be a delay of maximum 5 seconds.

Test Approach: Team will test the system interface at the base station using admin's credentials. The of the system response time latency will be measured to ensure that it meets the requirements for an acceptable latency time.

5.4 Safety Requirement

5.4.1 Drone Speed

Description: Drone should be able to fly with top speed of at least five mph and should be able reduce its speed to zero in order to hover.

Test Approach: Team will fly the drone in the neighborhood and record the speed of the drone and verified to the speed of at least five mph and reduce in the speed to zero in order to have hover.

5.4.2 Drone Height

Description: The maximum flying height of the drone will not exceed 30 feet and the lowest will be 100 feet.

Test Approach: Team will fly the drone in the neighborhood and record the maximum and the minimum height.

5.4.3 Safety Guide

Description: Safety guide will be provided, which will have detail description of safety measurements that needs to be followed while operating the drone.

Test Approach: Team will provide the safety guide to the user of NPD and verify the usefulness of the safety guide according to the user's operating the drone.

5.4.4 Error in GPS reception

Description: While flying, if the system loses its GPS reception, the system will auto land. And the system will notify the system administrator with its last known location so as to ease the manual retrieval.

Test Approach: Team will fly the drone in the neighborhood with unknown position and let the system to notify the system administrator with its last known location so as to ease the manual retrieval.

5.4.5 Auto Land System Failure

Description: The vehicle will be able to auto land when it detects low battery power. But, if an error arises in auto land functionality, the vehicle may crash and hurt someone.

Test Approach: Team will let the drone fly and land automatically as it detects lack of energy or GPS loss.

6. Features Not To Be Tested

This section will describe all the features and the requirement not to be tested in the Neighborhood Drone Patrolling (NPD). Each feature mentioned here not be tested and the reason for not testing will be provided below**.**

6.1 Customer Requirement

6.1.1 Solar Energy to Recharge Battery

Description: The vehicle shall utilize solar energy to recharge its batteries. Solar panels will be used as an extra source of energy to recharge drone on board batteries. The system will store excess solar energy in on board backup batteries if the main batteries are fully charged.

Reason: This requirement will not be tested because it is a future requirement and will not be implemented.

6.2 Packaging Requirements

All the packaging requirement will be tested due to its high importance to the customer safety and satisfactions..

6.3 Performance Requirements

The entire performance requirement will be tested as the system fails if it didn’t perform when being tested.

6.4 Safety Requirements

6.4.1 Rotor Blades

Description: System will have 4 rotor blades, when in operation it may injure any person or an animal if came in contact.

Reason: This requirement will not be tested because it is expected to be safe as we reviewed the safety while purchasing this item.

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7. Test Approaches

This section will describe about the testing methods that our team will be using to test the system. Different tools will be used to perform the test which will ensure the performance of functionality.

7.1 Strategy

A good test strategy is specific, practical and justified. The purpose is to specify the major task and the challenges of the project itself. Various test will be performed to avoid the risk of failure of the system while implementing the application. All the functions of the system will be tested thoroughly to ensure its proper functionality. Hardware component will be tested by hardware lead to ensure that all functionality is working and the defect on the component will be addressed immediately and replaced if necessary. A unit test will be performed in each module to ensure its correctness if the error or fault is found then it will be fixed and moved to another testing phase i.e. component testing. Each sub layer will have to go through the component testing without any error. If it passes the integration tests the component will be in the stable phase and the developer will then begin on a new task. If the component fails at any point during the testing phase it will revert back to the previous development phase and go through the testing process again. Once, all integration tests are considered successful, NPD System will begin the acceptance testing.

7.2 Testing Tools

- Python Unit Test Libraries
- Junit
- Selenium test

7.3 Core Functionality

- Register User
- Log in/out
- Display the user’s page or admin page
- Store the video for 5 days
- Capture the video
- Send Notification
- Set the height and speed of drone

7.4 Test Merits

Priority	Description	Pass criteria	Fail criteria
Critical	The most important feature of the system. These need to be completed in order for the system to work.	100%	< 100%
High	These features are not critical but might have some impact on critical features due to error in these features.	>= 90%	< 90%
Medium	These features have mild effect on the system. Should be fixed in order to avoid the minimal error.	>= 75%	< 75%
Low	These features do not have any impact on the system even if it is not fixed.	>= 10%	< 10%

Table 7-1: Test Metrics

8. Item Pass/Fail Criteria

8.1 Hardware Test

Test ID	Hardware	Pass Criteria	Fail Criteria
H1	Drone	User should be able to fly drone at a given location, height and speed.	When the drone doesn't fly at a given location, height and speed.
H2	Controller	When user takes the control, user should be able to take charge of the drone	When the drone is switched to auto pilot module, drone fails to respond to use command.
H3	Battery	Fly the drone for at least 6 – 10 mins	Battery drains before the allocated time.
H4	Camera	Capture the video of the neighborhood and record it while the drone is patrolling the neighborhood.	Does not record captured video of neighborhood while drone is patrolling the neighborhood**.**

Table 8-1: Hardware Test Pass/Fail criteria

8.2 Unit Tests

Test ID	Module/Unit	Pass Criteria	Fail Criteria
UHEH1	Radio Frequency Event Listener	• Receives data from drone, controller and battery • Communicate radio frequency from the drone, controller and battery.	• Fails to receive data from the drone, controller and battery. • Fails to communicate the radio frequency from the drone, controller and battery.
UHEH2	Digilog Converter	• Receives the sorted analog data from hardware. • Converts the received analog data to the digital.	• Fails to receive the sorted analog data from the hardware. • Fails to convert received data to digital.
UVIH1	Video Receiver	Receives the video stream from the camera of drone	Fails to receive video stream from the camera of drone.
URFH1	RF Communication	Receives the digital data from a specified piece of hardware.	Fails to receive the digital data from a specified piece of hardware.
URFH2	Video Packaging	Receives the converted digital video data.	Fails to receive the converted digital video data.

UAEH1	Admin Event Listener	Receives the admin's information when the user enters the user name and password.	Fails to receive the admin's information when the user enters the user name and the password.
UAEH2	Admin Data Identifier	Identifies the admin's information.	Fails to identify the admin's information.
UHEH1	User Event Listener	Receives the user's information when the user enters the user name and the password	Fails to receive the user's information when the user enters the user name and the password.
UHEH2	User Data Identifier	Identifies the user's information.	Fails to identify the user's information.
UDF1	Request Formatter	Differentiate the data input and event request	Fails to differentiate the data input and event request.
UDF2	Data Transporter	Receives the user's request such as viewing image, profile and so on	Fails to receive the user's request.
UHD1	Digital Drone Data	• Receives all the digital drone data. • Checks the incoming data constantly.	• Fails to receives digital drone data • Fails to check the incoming data constantly.
UHD2	Digital Video Data	Receives the incoming video feeds	Fails to receive the incoming video feeds.
UA1	Application Data Receiver	• Receives the user/admin's data • Identifies the types of request made.	• Fails to receives the user's /admin's data • Fails to identify the types of request made.
UMP1	Drone Data Processor	Identifies the types of data send.	Fails to identify the types of data send.
UMP2	Video Drone Data Processor	Receives the video in digital form.	Fails to receive the video in digital form.
UMP3	Admin Data Processor	Receives the request made by admin.	Fails to request made by admin.
UMP4	User Data Processor	Receives the request made by user.	Fails to receive the request made by user.
UMP5	Application Data Processor	Receives the data related to user's request	Fails to receive the data related to user's request
UMP6	Hardware Data Processor	Receives the data related to hardware component.	Fails to receive the data related to hardware component.
UDM1	Query Receiver	• Accepts the queries to perform different task such as storing, retrieving,	• Fails to accept the queries to perform different task such as storing, retrieving,

		authenticating a user, and checking. • Returns the requested data.	authenticating a user, and checking. • Fails to Returns the requested request.
UDM2	Query Sender	• Receives the Boolean value • Returns the requested data	• Fails to receives the Boolean value • Fails to returns the requested data
UOF1	User Output	• Accepts user data such as video and user info in the form of java object • Displays the user's page in web application and android application.	• Fails to accepts user data such as video and user info in the form of java object • Fails to displays the user's page in web application and android application.
UOF2	Admin Output	• Accepts admin's data such as video and user info in the form of java object • Displays the admin's page in web application and android application.	• Fails to accepts admin's data such as video and user info in the form of java object • Fails to displays the admin's page in web application and android application
UOF3	Output Identifier	• Accepts different data for user as a java object. • Identifies the various data and separated into the admin's data and user data.	• Fails to accept different data for user as a java object. • Fails to identify the various data and separated into the admin's data and user data.
UOC1	Output Receiver	• Accepts the data related to hardware and application in the form of JSON object • Formats the different data.	• Fails to accepts the data related to hardware and application in the form of JSON object • Fails to formats the different data.

Table 8-2: Unit test Pass/Fail criteria

8.3 Component Testing

Test ID	Subsystem	Pass Criteria	Fail Criteria
CH1	Hardware Event Handler	• Determine the origin of data from different hardware. • Converts analog data to the digital	• Fails to determine the origin of the data from different hardware component. • Fails to converts analog data to the digital
CH2	Video Input Handler	• Accepts the video Package • Formats the video	• Fails to accepts the video Package • Fails to formats the video
CH3	Radio Frequency Handler	• Accepts the Radio Frequency • Converts the analog data to the digital formats	• Fails to accepts the Radio Frequency • Fails to converts the analog data to the digital formats
CA1	Admin Event Handler	• Accepts the administrator's data • Determines the types of data to be delivered to perform the requested task.	• Fails to accepts the administrator's data • Fails to determine the types of data to be delivered to perform the requested task.
CA2	User Event Handler	• Accepts the user's data • Determines the types of data to be delivered to perform the requested task.	• Fails to accepts the user's data • Fails to determine the types of data to be delivered to perform the requested task.
CA3	Data Formatter	• Accept event data generated by the web application and android application. • Formats the various data send by user and admin into acceptable form for further action.	• Fails to accept event data generated by the web application and android application. • Fails to formats the various data send by user and admin into acceptable form for further action.
CP1	Hardware Data Controller	• Accepts the formatted radio frequency data	• Fails to accepts the formatted radio frequency data

		• Identify the action needed to be performed.	• Fails to identify the action needed to be performed.
CP2	Application Data Controller	• Accepts the formatted information or action from the user. • Identify the action to be performed by the system.	• Fails to accept the formatted information or action from the user. • Fails to identify the action to be performed by the system.
CP3	Main Processor	• Accepts the formatted hardware data and the application data. • Identify the action to be performed by the system.	• Fails to accept the formatted hardware data and the application data. • Fails to identify the action to be performed by the system.
CD1	Database Manager	Accepts queries for store/retrieve /validate data/ validate user.	Fails to accept queries for store/retrieve /validate data/ validate user.
CO1	Output Formatter	• Accepts user's data. • Display the admin's/user's request	• Fails to accept user's data. • Fails to display the admin's/user's request
CO2	Output Controller	Separate types of data to be outputted.	Fails to separate type of data to be outputted.

Table 8-3: Component Test Pass/Fail criteria

8.4 Integration Testing

Test ID	Layers	Pass Criteria	Fail Criteria
I1	Hardware Layer	• Accepts hardware data • Converts radio frequency into digital form.	• Fails to accepts hardware data • Fails to converts radio frequency into digital form.
I2	Application Layer	• Accepts application data. • Converts application data.	• Fails to accept application data. • Fails to converts application data.
I3	Processing Layer	• Process hardware and application data	• Fails to process hardware and application data.
I4	Database Layer	• Accepts queries • Returns requested data	• Fails to accept queries • Fails to returns requested data
I5	Presentation Layer	• Accepts application data and videos • Display the data in the android application and web application.	• Fails to accept application data and videos • Fails to display the data in the android application and web application.

Table 8-4: Integration Test Pass/Fail criteria

8.5 System Validation

Test ID	Systems	Pass Criteria	Fail Criteria
S1	Admin's Page	• Accepts the admin's information • Displays the admin's page. • Provide the various function for admin such as add/edit/delete user , view stored video or live caste of video	• Fails to accepts the admin's information • Fails to displays the admin's page. • Fails to provide the various function for admin such as add/edit/delete user , view stored video or live caste of video
S2	User's Page	• Accepts the user's information • Displays the user's page. • Provide the various functions for user such as view stored video and there information.	• Fails to accepts the user's information • Fails to displays the user's page. • Fails to provide the various function for user view stored video and their information.
S3	Drone Performance	• Accepts the location, height and the speed for the drone. • Fly the drone around the neighborhood at a given location height and speed.	• Fails to accept the location, height and the speed for the drone. • Fails to fly the drone around the neighborhood at a given location height and speed.
S4	Ease of Use	• User able to fly the drone without any difficulties using the instruction provided.	• User not being able to fly drone with the instruction provided.

Table 8-5: system Validation Test Pass/Fail criteria

9. Test Deliverables

This section will describe what the team will deliver after the each test is performed. This section will include what is tested, how it is tested and any documentation or logs associated with them. This section will help the supervisor, customer and the user of the system to get an idea of what to expect in regarding documentation logs, and other files that will be used to test the system and keep track of the results.

9.1 Deliverables

9.1.1 System Test Plan

This section provide the detail view of test that took place, how the test was performed ,what the team expects the test results to be, and the pass/fail criteria for each test.

9.1.2 Test Cases

Each test case will have the following:

- Test Case ID: Id for each test case.
- Test Case Result ID: Id for each test result.
- Author: Name of the team member who created test case.
- Description: A general description of the test case.
- Test Steps: Steps to run the test case, including any necessary inputs/outputs needed.
- Comments: Comments or special conditions needed to run test case.
- Priority: The priority of the test will be mentioned (low, medium, high)

9.1.3 Test Case Result

Each test case's result will have the following

- Test case ID: Id for each test case.
- Test case result: Id for each test result.
- Author: Name of the tester who created the test.
- Date/Time: Date and time when the test was performed.
- Result: Result for the each test.
- Comments: Any comments relevant to the test and the description of the error.

9.1.4 Bug/defect Result

Each bug/defect will have the following

- Test case ID: Id for the test case.
- Bug /defect Id: Id for the bugs/defect.
- Description: description of the bug or defect encountered.

- Types of bugs encountered.
- Author: Name of the tester who performed the test.
- Test Date: Date when the test was performed.
- Severity: How important is this defect.
- Status: Current status of the test case.
- Comment: Comment on bug or defect.

10. Test Schedule

WBS	Task Name	Baseline Start	Baseline Finish	Planned Value BCWS (hours)
2.8	**System Test**	**Mon 4/6/15**	**Fri 5/1/15**	**186.5**
2.8.1	**Phase One Hardware Test**	**Thu 4/2/15**	**Thu 4/9/15**	**5.5**
2.8.1.1	Drone	Wed 4/8/15	Thu 4/9/15	3
2.8.1.2	Controller	Mon 4/6/15	Mon 4/6/15	1
2.8.1.3	Battery	Tue 4/7/15	Tue 4/7/15	0.5
2.8.1.4	Camera	Thu 4/2/15	Mon 4/6/15	1
2.8.2	**Phase Two Unit Test**	**Wed 4/8/15**	**Tue 4/14/15**	**70**
2.8.2.1	Radio Frequency Event Listener	Wed 4/8/15	Thu 4/9/15	2
2.8.2.2	Digilog Converter	Wed 4/8/15	Thu 4/9/15	1
2.8.2.3	Video Receiver	Wed 4/8/15	Sat 4/11/15	5
2.8.2.4	RF Communication	Wed 4/8/15	Sat 4/11/15	3
2.8.2.5	Video Packaging	Wed 4/8/15	Mon 4/13/15	2
2.8.2.6	Admin Event Listener	Wed 4/8/15	Thu 4/9/15	1
2.8.2.7	Admin Data Identifier	Wed 4/8/15	Thu 4/9/15	1
2.8.2.8	User Event Listener	Wed 4/8/15	Thu 4/9/15	3
2.8.2.9	User Data Identifier	Thu 4/9/15	Fri 4/10/15	3
2.8.2.10	Request Formatter	Thu 4/9/15	Fri 4/10/15	2
2.8.2.11	Data Transporter	Thu 4/9/15	Fri 4/10/15	2
2.8.2.12	Digital Drone Data	Thu 4/9/15	Sat 4/11/15	3
2.8.2.13	Digital Video Data	Wed 4/8/15	Sat 4/11/15	4
2.8.2.14	Application Data Receiver	Wed 4/8/15	Fri 4/10/15	2
2.8.2.15	Drone Data Processor	Wed 4/8/15	Sun 4/12/15	2
2.8.2.16	Video Drone Data Processor	Thu 4/9/15	Mon 4/13/15	5
2.8.2.17	Admin Data Processor	Wed 4/8/15	Thu 4/9/15	2
2.8.2.18	User Data Processor	Thu 4/9/15	Fri 4/10/15	2
2.8.2.19	Application Data Processor	Wed 4/8/15	Thu 4/9/15	3
2.8.2.20	Hardware Data Processor	Wed 4/8/15	Sun 4/12/15	3
2.8.2.21	Query Receiver	Thu 4/9/15	Sat 4/11/15	4
2.8.2.22	Query Sender	Thu 4/9/15	Sat 4/11/15	4
2.8.2.23	User Output	Thu 4/9/15	Sat 4/11/15	3
2.8.2.24	Admin Output	Thu 4/9/15	Sat 4/11/15	4
2.8.2.25	Output Identifier	Thu 4/9/15	Sat 4/11/15	2
2.8.2.26	Output Receiver	Thu 4/9/15	Mon 4/13/15	2
2.8.3	**Phase Three Component Testing**	**Tue 4/14/15**	**Sat 4/25/15**	**60**
2.8.3.1	Hardware Event Handler	Tue 4/14/15	Fri 4/17/15	5
2.8.3.2	Video Input Handler	Sun 4/19/15	Fri 4/24/15	6
2.8.3.3	Radio Frequency Event Handler	Thu 4/16/15	Sun 4/19/15	4
2.8.3.4	Admin Event Handler	Tue 4/14/15	Wed 4/15/15	4

2.8.3.5	User Event Handler	Tue 4/14/15	Wed 4/15/15	4
2.8.3.6	Data Formatter	Fri 4/17/15	Mon 4/20/15	4
2.8.3.7	Hardware Data Controller	Wed 4/15/15	Sat 4/18/15	6
2.8.3.8	Application Data Controller	Wed 4/15/15	Sat 4/18/15	3
2.8.3.9	Main Processor	Wed 4/15/15	Fri 4/24/15	10
2.8.3.10	Database Manager	Tue 4/14/15	Wed 4/15/15	8
2.8.3.11	Output Formatter	Tue 4/14/15	Wed 4/15/15	3
2.8.3.12	Output Controller	Tue 4/14/15	Wed 4/15/15	3
2.8.4	**Phase Four Integration Testing**	**Sat 4/25/15**	**Thu 4/30/15**	**30**
2.8.4.1	Hardware Layer	Sat 4/25/15	Thu 4/30/15	8
2.8.4.2	Application Layer	Sat 4/25/15	Thu 4/30/15	3
2.8.4.3	Processing Layer	Sat 4/25/15	Thu 4/30/15	10
2.8.4.4	Database Layer	Sat 4/25/15	Thu 4/30/15	5
2.8.4.5	Presentation Layer	Sat 4/25/15	Thu 4/30/15	4
2.8.5	**Phase Five System Validation**	**Thu 4/30/15**	**Tue 4/7/15**	**21**
2.8.5.1	Admin's Page	Thu 4/30/15	Tue 4/7/15	5
2.8.5.2	User's Page	Thu 4/30/15	Tue 4/7/15	6
2.8.5.3	Drone's Performance	Thu 4/30/15	Tue 4/7/15	7
2.8.5.4	Ease of Use	Thu 4/30/15	Tue 4/7/15	3

Table 10-1: System Testing Schedule

11. Approvals

Name	Title	Signature	Date
Mr. Bill Farley	Sponsor		
Mr. Mike O'dell	Supervisor		
Mr.Nabin Adhikari	Team Lead		
Mr. Arvind Swaminathn	Team Member		
Mr. Ashesh Rana	Team Member		
Miss. Shreemila Rajwant	Team Member		

Table 11-1: Approval Signatures